Defense System Needs for Dynamic Switching in the Optical Domain

03/18/03

Rick Stevens
rick.c.stevens@lmco.com
(651)456-3118

Agenda

Defense System Platforms/Applications

Computing/Interconnect Demands

Environmental Requirements

Architecture Using Dynamic Switching

Technical Hurdles

Defense System Platforms/Applications

Platform/Application Driving Requirements

- ***Sensor Preprocessing***
- ***Sensor/Image Registration***
- ***Multi-sensor Fusion***
- ***Target Identification/Tracking***
- ***On-board/Off-board Information Sharing***
- ***Advanced Vehicle Monitoring***
- ***Advanced Vehicle Management***
- ***Autonomous Operations***
- ***Active Replanning/Retargeting***
- ***Precision Targeting and Weapon Hand-off***
- ***Active and Passive Countermeasures***
- ***Battle Damage Assessment***
- ***Information Compression/Decompression***
- ***Information Encryption/Decryption***

Computing/Interconnect Demands

- *Each of these driving requirements demand high performance computing and associated high performance interconnects*
- *COTS parallel processing enables these applications to be achievable for military platforms*
- *Affordable parallel processing systems now out-perform the best conventional supercomputers*
- *Performance per dollar is particularly favorable*
- *Hardware Framework is Clusters*
  - *Distributed Shared Memory (256 processors)*
  - *PCs (256/NT & 128/Linux)*

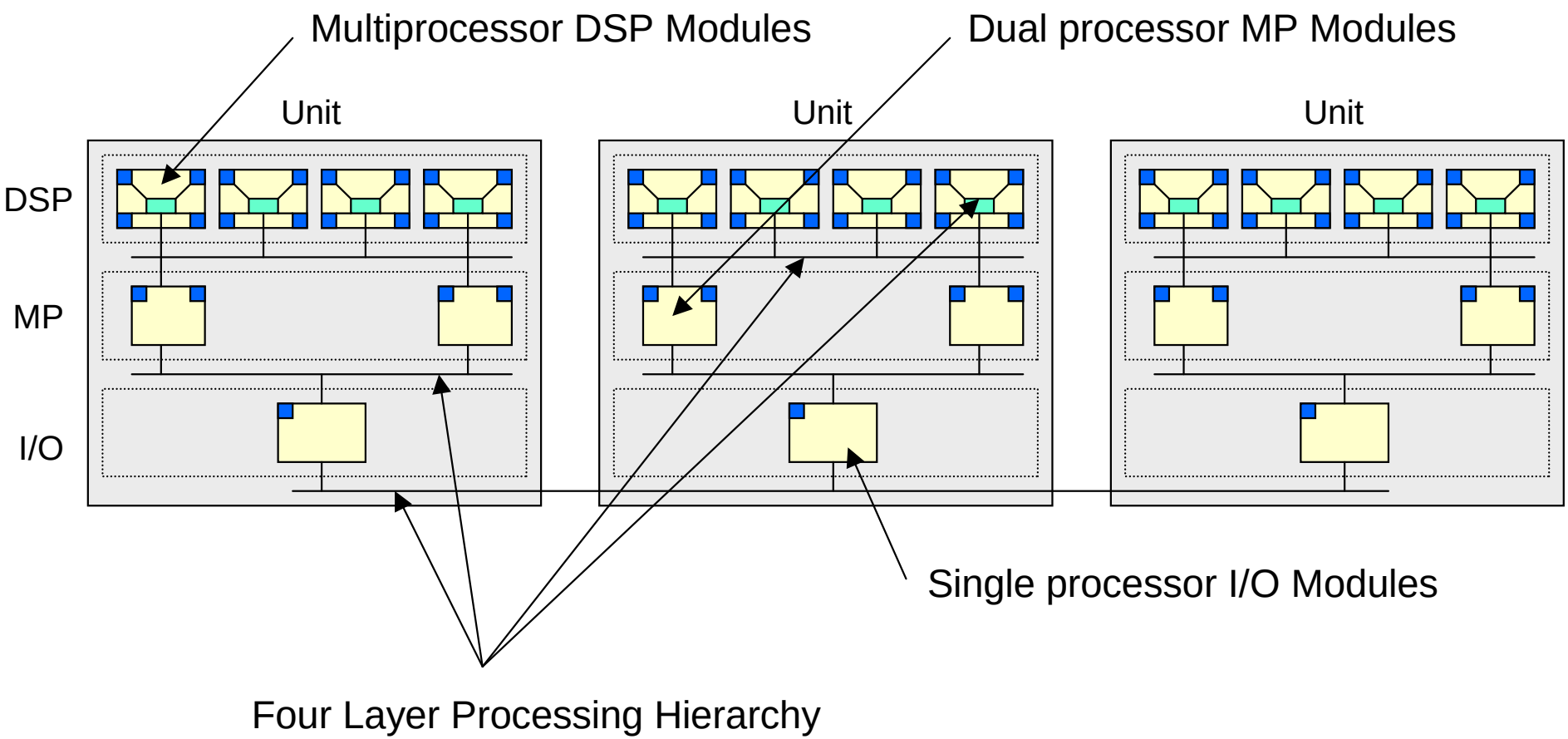
Large Low-Latency O/E/O Switches are a Key Element in Parallel Processing Systems

Environmental Requirements

- *Military platforms can be severely space limited (tactical aircraft, UAVs, Space Vehicles, etc.)*
- *Military platforms can be exposed to high levels of electromagnetic interference*
- *Military platforms can be required to operate in harsh conditions (shock, vibration, temperature, altitude, humidity, etc.)*
- *Long term support demands a high level of reliability and maintainability*
- *Minimal Total Ownership Cost (TOC) required to support platform for 30+ years*

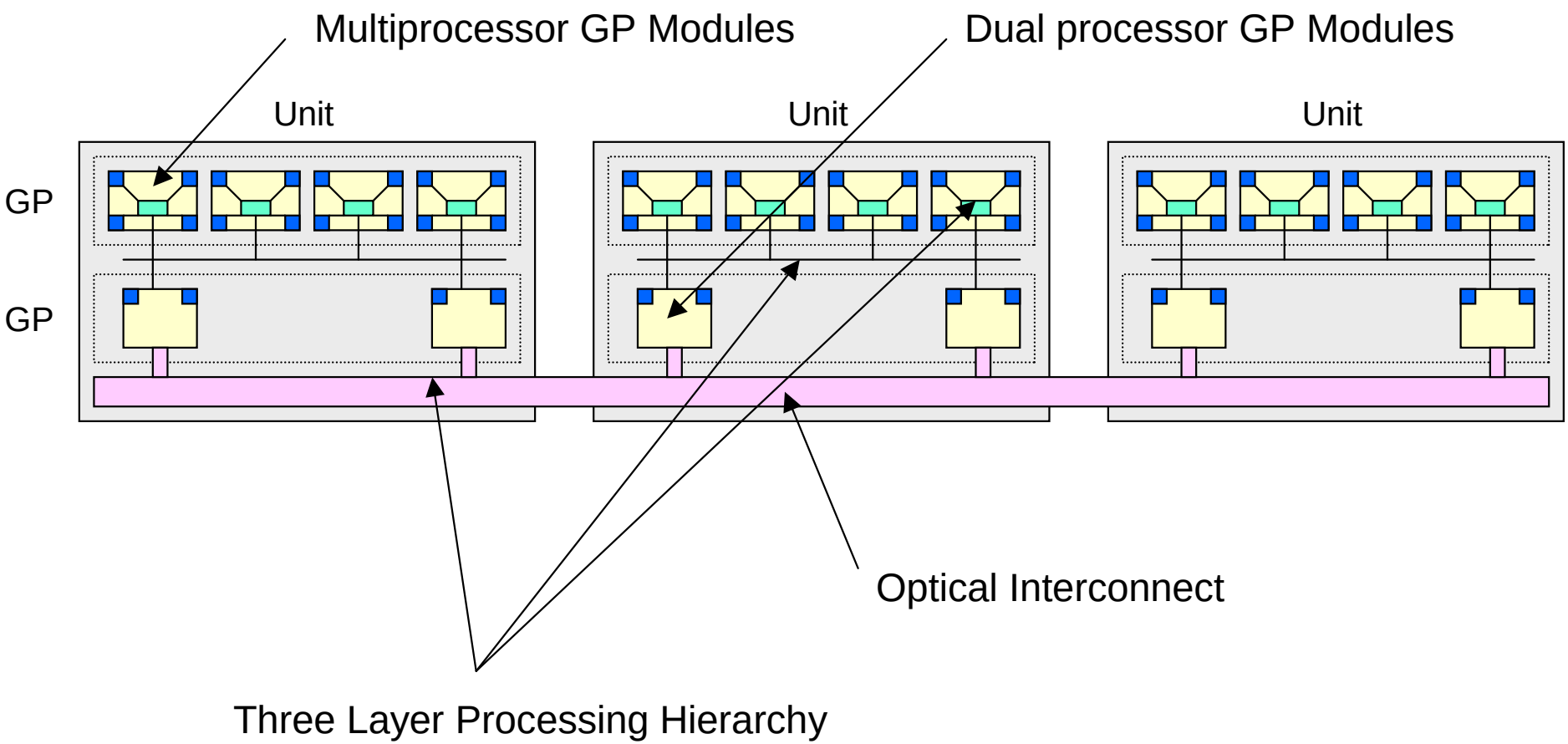
Dynamic Optical Domain Switching has the potential to provide a greater level of support towards achieving these requirements

Federated Architecture (legacy systems)



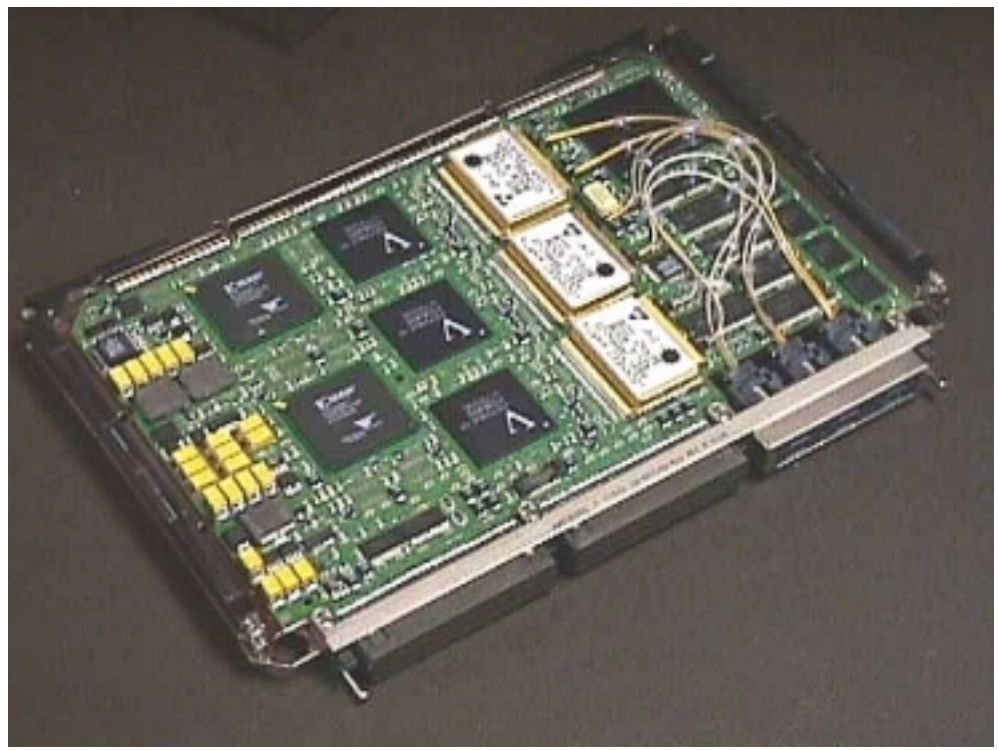
With each layer in the architecture the interconnect latency increases and the bandwidth decreases.

Cluster Integrated Architecture (current systems)

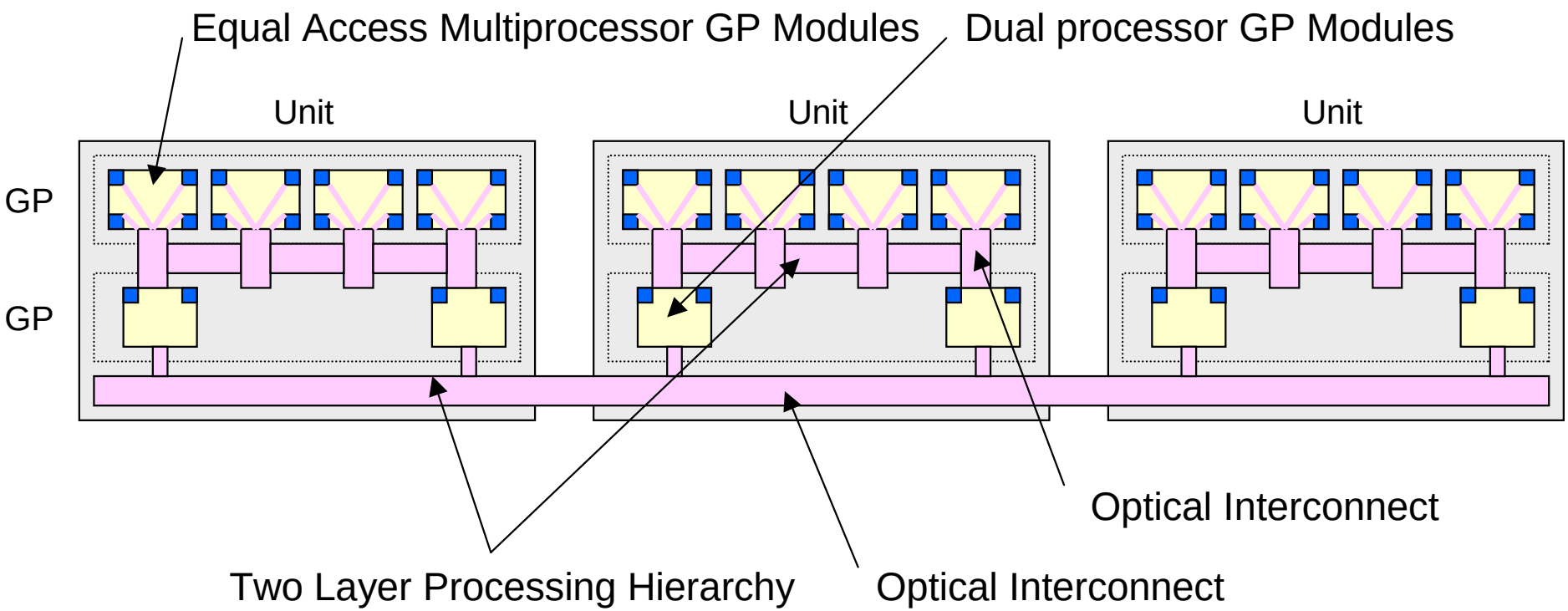


Current Implementation Issues

- ***High cost for O/E/O conversion***
- ***Large size (16-32 channels per module)***
- ***High power (+100 Watts for 24 channel switch)***
- ***Single point failure***
- ***Not scalable***
- ***Low reliability***



Integrated Architecture (future systems)



Dynamic Optical Domain Switching capability enables scalability at the processor level and not the cluster level. This will result in the more effective use of each processor.

Technical Hurdles

- ***Optical decoding of routing information within packets***
- ***Optical switching or routing***
- ***Flow control:***
  - ***Packet buffering***
  - ***In order delivery***
  - ***Hot spots***
  - ***Priority allocation***
  - ***Realtime determinism***
  - ***Generation of response packets***
- ***Fault detection/fault isolation***
- ***Manufacturable process***
- ***Affordability***
- ***Packaging***
- ***Integration with current board development/routing/layout tools***